

Orion Exploration Flight Test Reaction Control System Jet Interaction Heating Environment from Flight Data

Authors: Molly E. White, Andrew J. Hyatt

The Orion Multi-Purpose Crew Vehicle (MPCV) Reaction Control System (RCS) is critical to guide the vehicle along the desired trajectory during re-entry. However, this system has a significant impact on the convective heating environment to the spacecraft. Heating augmentation from the jet interaction (JI) drives thermal protection system (TPS) material selection and thickness requirements for the spacecraft. This paper describes the heating environment from the RCS on the afterbody of the Orion MPCV during Orion's first flight test, Exploration Flight Test 1 (EFT-1). These jet plumes interact with the wake of the crew capsule and cause an increase in the convective heating environment. Not only is there widespread influence from the jet banks, there may also be very localized effects. The firing history during EFT-1 will be summarized to assess which jet bank interaction was measured during flight. Heating augmentation factors derived from the reconstructed flight data will be presented. Furthermore, flight instrumentation across the afterbody provides the highest spatial resolution of the region of influence of the individual jet banks of any spacecraft yet flown. This distribution of heating augmentation across the afterbody will be derived from the flight data. Additionally, trends with possible correlating parameters will be investigated to assist future designs and ground testing programs. Finally, the challenges of measuring JI, applying this data to future flights and lessons learned will be discussed.